

INSTITUTIONAL AND POLICY ANALYSIS OF RIVER BASIN MANAGEMENT

The Jaguaribe River Basin, Ceará, Brazil¹

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World Bank Policy Research Working Paper 3649, June 2005

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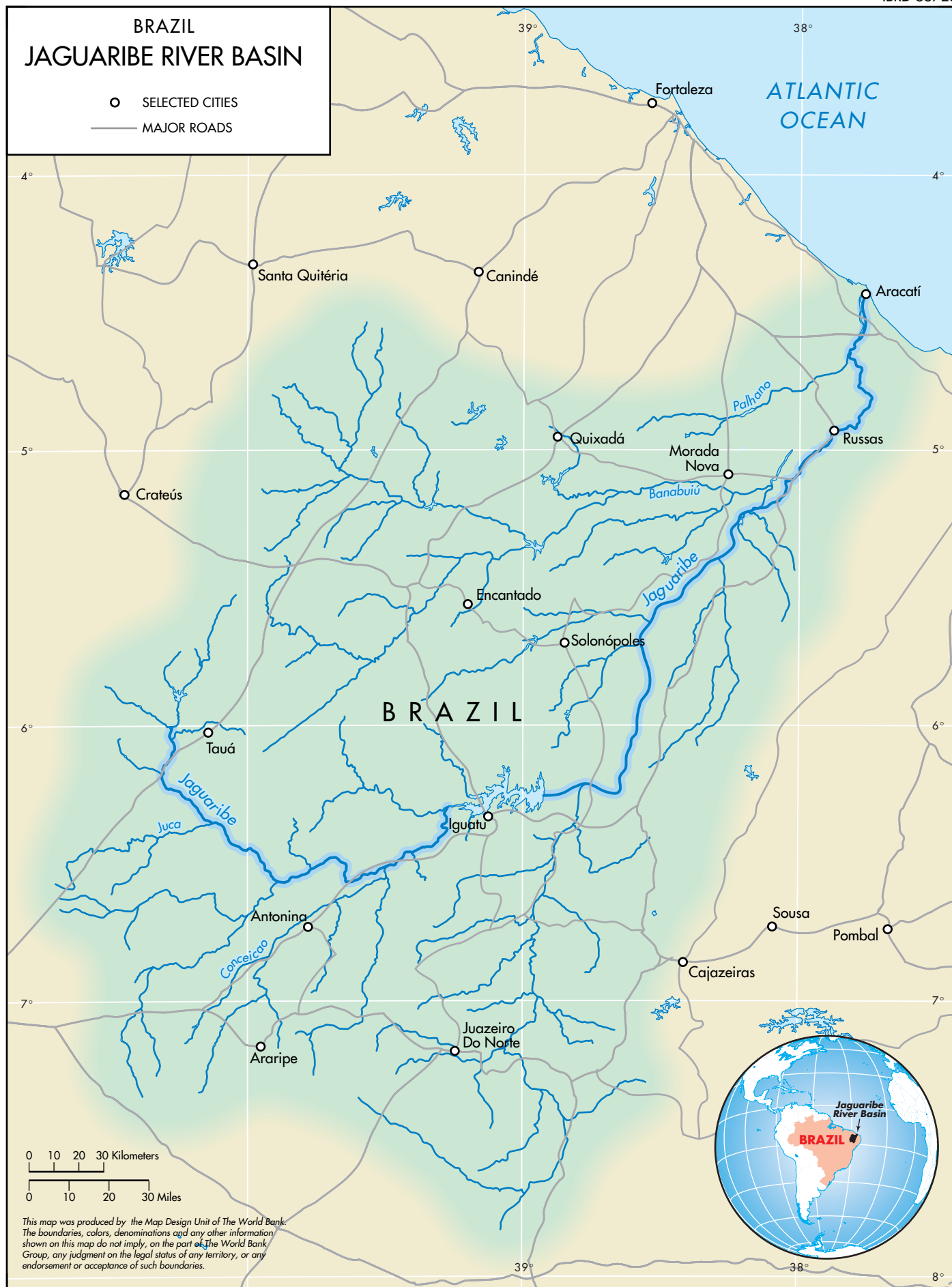
¹ This paper is a product of the study, “Integrated River Basin Management and the Principle of Managing Water Resources at the Lowest Appropriate Level – When and Why Does It (Not) Work in Practice?” The Research Support Budget of the World Bank provided major funding. The project was carried out by the Agriculture and Rural Development Department at the World Bank. The Water Resources Management Group and the South Asia Social and Environment Unit at the World Bank have provided additional support. The study core team includes Karin Kemper and Ariel Dinar (Co-Task Team Leaders, World Bank), William Blomquist and Anjali Bhat (consultants, Indiana University), and Michele Diez (World Bank), William Fru (consultant), and Gisèle Sine (International Network of Basin Organizations). Basin case study consultants include Maureen Ballesteros (Tárcoles - Costa Rica), Ken Calbick and David Marshall (Fraser - Canada), Rosa Maria Formiga Johnsson (Alto Tietê and Jaguaribe - Brazil), Consuelo Giansante (Guadalquivir - Spain), Brian Haisman (Murray Darling - Australia), Kikkeri Ramu and Trie Mulat Sunaryo (Brantas - Indonesia), and Andrzej Tonderski (Warta - Poland). – Reviews and valuable comments on this paper by Larry Simpson, João Lúcio F. de Oliveira, Francisco Teixeira and Rebecca Abers are gratefully acknowledged.

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BRAZIL JAGUARIBE RIVER BASIN

- SELECTED CITIES
- MAJOR ROADS



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1. Background and Introduction

Since the early 1990s, Brazil has been building a new water resource management system, with the river basin as the territorial unit for planning and management. New water legislation was first approved in the state of São Paulo in the early 1990s, followed by Ceará in 1992 and subsequently several other states. The National Water Law, approved in 1997, confirmed that Brazilian water management had entered a new era, embracing the main aspects of the new approach taken by the states that pioneered reform in the sector. These laws were based on a series of principles, in consonance with those recommended by major international charters such as the Dublin Statement of 1991, i.e. sectoral integration, decentralization of water management to the river basin level, the participation of stakeholders, and the concept of water as an economic good while guaranteeing priority for human consumption. With some variations, the Brazilian national and state water laws included the creation of two new river basin management institutions, largely based on the French experience: stakeholder committees and water agencies, the “executive arm” of these committees. The laws also created a new water management instrument: bulk water charges, which would give financial autonomy to the new basin institutions. The concession and control of water user rights remain under the jurisdiction of either federal or state governments, since under the Brazilian Constitution of 1988, waters that cross state or international boundaries are in federal jurisdiction, while those located entirely within the territory of a single state as well groundwater resources are in state domain².

One of the most advanced cases of water management reform in Brazil is occurring in the state of Ceará, in the semi-arid northeastern region of the country. Among the poorest states of the country, characterized by a patriarchal political culture and extreme socio-economic inequalities, with a state government inexperienced in water management, Ceará would not have been a likely place to expect advances in promoting decentralized stakeholder models of water management. But, based on a more centralized model of water management than that proposed by the national water law, Ceará state has involved large numbers of stakeholders in key water management questions and created a state water management agency and decentralized institutions that are impressively strong, considering the context within which they grew.

These changes have gone furthest in the Jaguaribe River Basin, the subject of this Working Paper, which is part of an international study of experiences in decentralizing integrated water management to the lowest appropriate level. The larger study, supported by the World Bank, seeks to evaluate the extent to which river basin management efforts have been successful and to identify the factors that can be associated with both positive and negative outcomes. An important consideration in this context is that “the lowest appropriate level” for integrated river basin management varies between countries, states and even basins. For this reason, the methodology necessarily needs to take into account the hydrological, socio-economic, cultural and historical conditions in the case study

² One major exception is also established in the 1988 Constitution: state waters collected in or regulated by federal structures are under federal jurisdiction. This norm is especially relevant in the semi-arid Northeast, where the majority of reservoirs were built by federal agencies in charge of drought prevention policies and programs.

areas. The present research project explores these factors both through a survey of river basin organizations throughout the world and case studies of eight river basins, namely the Murray Darling River basin in Australia, the Fraser basin in Canada, the Tárcoles basin in Costa Rica, the Brantas basin in Indonesia, the Warta basin of Poland, the Guadalquivir basin in Spain, and the Alto Tietê and Jaguaribe basins in Brazil.

In the next two sections, the analytical framework and methodology of the study are presented. The paper then goes on to describe the physical aspects of the Jaguaribe basin, the institutional arrangements that have been created there, and the role of stakeholders in these institutions. It then further examines these changes through the lens of the analytical framework presented. This involves looking at how a series of factors affect the evolution of decentralization, such as initial conditions and context, the level of commitment to decentralization on the part of both central and local authorities, the capacities of central and local institutions, and the design of basin-level institutions. Finally, the paper will assess the performance of the decentralization process by examining three critical factors: devolution of authority, stakeholder participation and financial self-sustainability.

2. Analytical Framework

This case study follows the analytical framework developed for this research project and is applied to all eight case studies. The literature on institutional analysis of natural resource management and decentralization identifies a series of political and institutional factors associated with the emergence and sustainability of stakeholder-based, decentralized arrangements (Ostrom 1990, 1992; Agrawal 2000; Alaerts 1999; Blomquist and Schlager 1999; Bromley 1999; Easter and Hearne 1993; and Wunsch 1991). The study seeks to evaluate how these factors operate in each of the empirical settings considered.

The framework explores a series of political and institutional variables.

i) Contextual factors and initial conditions. The literature on decentralized water resource management suggests that successful decentralization is at least partly associated with the social context at the time a decentralization initiative is attempted, including:

- Economic development of the nation;
- Economic development of the basin area;
- Initial distribution of resources among basin stakeholders; and
- Class, religious, or other social/cultural distinctions among basin stakeholders.

ii) Characteristics of the decentralization process. In countries that have attempted to decentralize water resource management to the basin level, characteristics of the decentralization process itself will affect the prospects for successful implementation. Two necessary conditions of a decentralization initiative are (a) devolution of authority and responsibility from the center, and (b) acceptance of that authority and responsibility by local or regional units. Whether (a) and (b) occur will depend in part upon why and how the decentralization takes place. Important factors include

- Whether basin-level management was a local initiative, a devolution that was mutually desired by local stakeholders and central government officials, or a decision by central government officials to release themselves of responsibilities regardless of whether basin stakeholders wanted to assume them;
- The extent of central-government recognition of local-level basin governance; and,
- Whether commitment to decentralization and basin management is maintained after transitions in central government administration.

iii) Characteristics of central government/basin-level relationships and capacities. Because successful decentralization requires complementary actions at the central government and local levels, other aspects of the central-local relationship can be expected to affect that success. Political and institutional variables should be explored that relate to the respective capacities of the central government and the basin-level stakeholders, and the relationship between them. Key factors include

- The extent to which devolution of water management responsibilities from central government to basin institutions has been real or merely rhetorical, and whether devolution has been handled as a supportive transition to basin management or as an abrupt abandonment of central government authority;
- The financial resources available to basin-level institutions, and the extent of their financial autonomy;
- The ability of basin management participants to create and modify institutional arrangements according to their needs and circumstances;
- The existence of other experience in the country with local self-governance and service provision;
- The distribution of national-level political influence among basin stakeholders;
- The extent to which the country's water rights system facilitates or hinders basin management efforts; and
- Whether basin-level institutions have had adequate time for implementation and adaptation of basin management activities.

iv) The internal configuration of basin-level institutional arrangements. Successful implementation of decentralized water resource management will also depend on features of the basin-level arrangements. Important aspects include

- The presence of basin-level governance institutions;
- The extent to which there is clarity about institutional boundaries, and whether these match with basin boundaries;
- Whether and to what extent basin-level institutional arrangements recognize sub-basin communities of interest;

- The availability of fora for information-sharing and communication among basin stakeholders;
- The ability to make, monitor, and enforce contingent contracts through which basin stakeholders can contribute to improvements in basin conditions;
- The institutionalization of basin monitoring systems that have credibility among water users; and
- The availability of fora for conflict resolution.

The analytical framework presumes that in each case, some factors will have stronger impacts than others. The goal of the research is, therefore, not to describe in detail how each of these factors operate in every case, but to identify which ones are more powerful indicators of outcomes in each setting and how under different conditions, these factors combine in different ways. The study is also based on the assumption that, on the ground, participants and observers are likely to have different assessments of many of these variables, requiring the researcher to interview people with varying perspectives and positions.

3. Methodology

To explain and analyze the decentralization processes of water resources management in the Jaguaribe River Basin, research for this paper followed the approach defined for all case studies in the larger project. This included the examination of primary documents on the basin and on the organizations involved and of a background paper prepared prior to field work³. Then, interviews were conducted with stakeholders in the field.

Two field visits were carried out, during which team members met with and interviewed a range of individuals, including past and current federal and state government officials, current officials in water institutions, members of basin committees from all sectors (water users, municipalities, and organizations of civil society), and of user commissions. The interviews sought to understand how decentralization efforts have affected current institutional arrangements for water management at the sub-basin, basin and state levels and to evaluate the performance of these arrangements. The next step was to revise the background paper based on the interviews and information gathered during the field visits. Finally, this paper summarizes and analyzes the current situation of water management in the Jaguaribe River Basin.

4. The Jaguaribe River Basin

With an estimated 12% of the world's surface water⁴, Brazil is usually viewed as wealthy in terms of water resources. This abundance at the national level, however, masks situations of often dramatic, localized scarcity and conflicts among water uses. Water

³ The background paper for the Brazilian cases —Jaguaribe and Alto-Tietê River Basins — was prepared by Rosa Maria Formiga Johnsson and is available at www.worldbank.org/riverbasinmanagement

⁴ Surface water availability is 182,600 m³/s, which reaches 272,000 m³/s if one considers the flow from neighboring countries into the Amazon river basin. The total volume of groundwater resources is estimated at 112 billion m³ (ANA, 2002).

resources are distributed unevenly throughout the country, concentrated in areas of low population density, while most regions are characterized by increasing pressure on the resource.

Most of Brazil's freshwater resources (75%) are located in the Amazon river basin, which covers 48% of the country's territory, but harbors only 4% of its population and is responsible for only a tiny proportion of the nation's industrial development. The opposite extreme can be found in the Northeast region, which includes almost the entire semi-arid region of Brazil, the so-called "Drought Polygon" (Figure 1). Accounting for 18% of Brazil's territory and about 28% of its population, this region has only 5% of the country's water resources. The current case study is particularly illustrative of the main problems faced by water management in these regions.

The Jaguaribe river basin is an independent basin in the Atlantic hydrographic region of Brazil's Northeast, located entirely within the state of Ceará. It has a drainage area of 72,560 square kilometers, covering approximately 48% of the state's territory. The principal river runs from south to north for about 610 km, flowing into the Atlantic Ocean (Cogerh/Engesoft, 1999d). The basin has 80 municipalities and more than 2 million people, representing about a third of Ceará's population. After an intense process of urbanization in recent decades, the majority of the basin's population (over 55%) now lives in urban areas, still well below the state and national averages (of 72% and 81% respectively). Figure 1 shows the location of the Jaguaribe River Basin within Ceará, its hydrographic regions, major rivers and cities.

Most of the Jaguaribe basin falls within the semi-arid region known as the *sertão* (hinterland). Precipitation is highly variable, ranging from 400 mm in the hinterland to 1,200 mm along the coast. Although such rates of rainfall are higher than in many dry regions in the world, in Ceará the combination of impermeable crystalline rocks in the soil and high temperatures produce elevated rates of evapotranspiration — over 2,000 mm for the basin— and low levels of water retention and storage. Groundwater resources are considered of limited importance in most areas of the basin. Cyclical droughts occur at least every five years and can persist over several years (Cogerh/Engesoft, 1999a, 1999b and 1999c).

Without regulation, all of the basin's rivers would be intermittent, flowing only during the rainy season. The state's —and previously the federal government's— main policy strategy has therefore been to store water resources in reservoirs for the dry season and possible subsequent drought years. The result is that water resources infrastructure in the Jaguaribe Basin was already well developed before the decentralization process began. The basin has an estimated 4,713 reservoirs and a total storage capacity of 13,560 million cubic meters. Seventy-five percent of this water availability is provided by three reservoirs⁵ which have transformed about 470 kilometers of rivers in the middle and lower part of the basin (Jaguaribe and Banabuiú Valleys) into perennial waterways, directly benefiting 19 municipalities and changing the economic and political profile of the region. These reservoirs are also the main water sources for Ceará's capital city,

⁵ The Orós reservoir (1.94 billion m³), the Banabuiú reservoir (1.60 billion m³) and the newly completed Castanhão reservoir (6.70 billion m³).

Fortaleza, and its metropolitan area, the state's largest urban and industrial area, which, importantly, lies outside the basin.

For management purposes, the Jaguaribe basin has been divided into five hydrographic regions, corresponding to three parts of the basin (upper, middle and lower) and to two sub-basins: Upper Jaguaribe, Middle Jaguaribe, Lower Jaguaribe, Salgado and Banabuiú (see Figure 1). Table 1 shows the principal characteristics of each part.

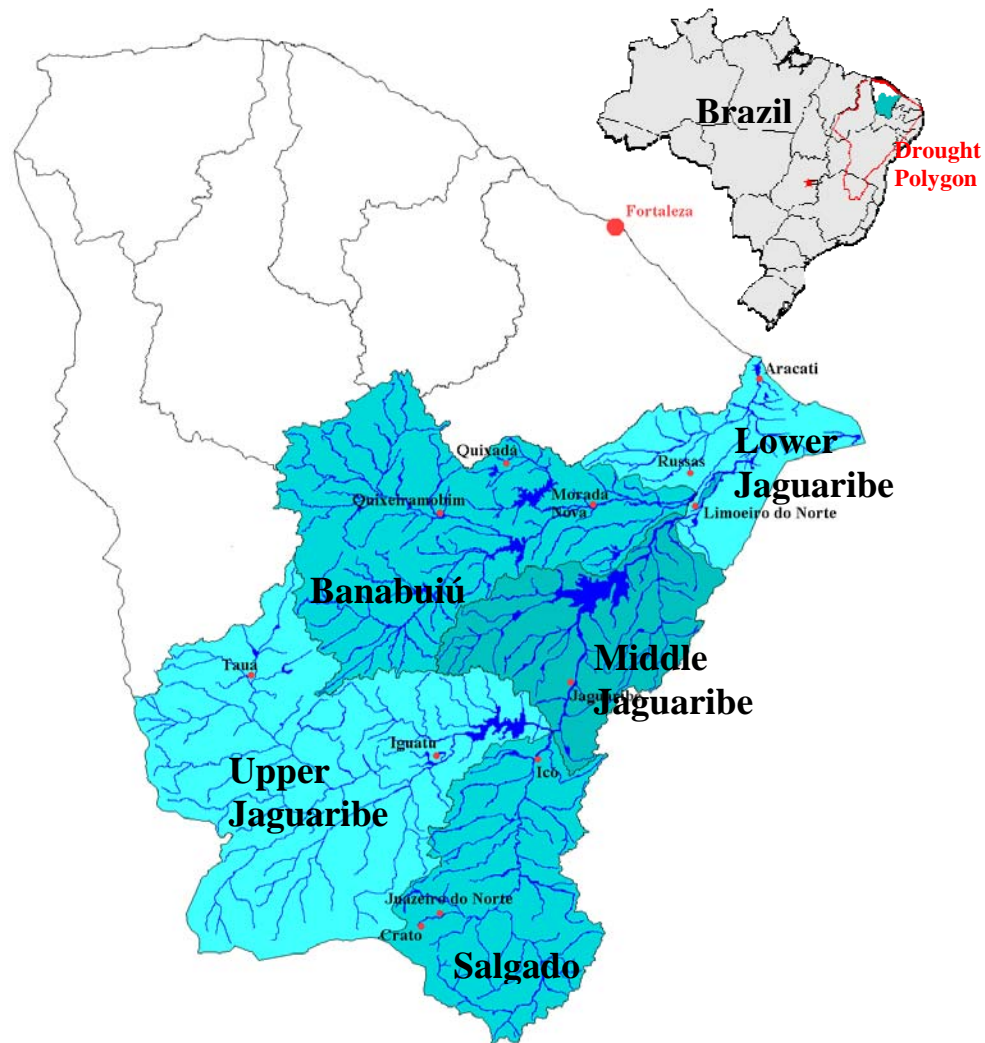


Figure 1: Jaguaribe River Basin in Ceará State, Brazil, its hydrographic regions and major cities

Source: Adapted from COGERH, n.d.

Table 1: Jaguaribe River Basin: principal characteristics, by sub-basin

Sub-basin	Principal characteristics
Upper Jaguaribe <i>Largest hydrographic region with extensive ‘vazios hídricos’ (literally “waterless space”)</i>	Area: 24,538 km ² ; 24 municipalities 16 strategic ⁶ reservoirs, total capacity of 2.57 billion m ³ <i>Agriculture, cattle ranching, and the income of social security pensioners.</i>
Salgado <i>Most important aquifer systems (Cariri region)</i>	Area: 13,275 km ² ; 23 municipalities 628 reservoirs, 13 strategic ones with a total capacity of 447.41 million m ³ <i>Service economy</i>
Middle Jaguaribe <i>Largest storage capacity; largest reservoir in Ceará State (Castanhão)</i>	Area: 10,509 km ² ; 13 municipalities 1,210 reservoirs, 11 strategic ones with a total capacity of 6.85 billion m ³ <i>Impoverished economy</i>
Banabuiú <i>Most numerous water storage structures in the Jaguaribe Basin</i>	Area: 19,580 km ² ; 12 municipalities 1,594 reservoirs, 17 strategic ones with a tot. capacity of 2.7 billion m ³ <i>Agriculture and cattle ranching</i>
Lower Jaguaribe <i>Principal beneficiary of the regulation of the Jaguaribe Valley</i>	Area: 8,893 km ² ; 9 municipalities 207 reservoirs, 1 strategic one with a capacity of 27.7 million m ³ <i>Expanding economy, especially in tourism, irrigation and shrimp farming. Largest irrigation potential in the basin.</i>

Source: Garjulli, Oliveira, Cunha *et al*, 2002; and Cogerh/Engesoft, 1999b.

In general, the basin is considered poor, even for Ceará, a state that contributes only 1.8% to the nation's GNP.⁷ Indeed, 63% of the state's income is generated by Greater Fortaleza, mostly from the service sector (56%) followed by the industrial and agricultural/ranching sectors (38% and 6% respectively). The Jaguaribe basin follows the state trend, with most of its income deriving from the service sector. Although agriculture accounts for only a small part of the basin's income, it is of great social importance since subsistence agriculture (dependent on rainfall) still employs most of the rural and poor basin population.

5. Basin Management Issues and Stakeholders

Water scarcity and recurrent droughts. For the last 100 years, the dominant management issues in the Jaguaribe Basin have been water scarcity and drought exposure. Until the beginning of the reform process in the early 1990s, this issue was treated as essentially a supply problem to be resolved through what is locally referred to as the *solução hidráulica* (“hydraulic solution”), *i.e.* through the massive construction of

⁶ “Strategic Reservoirs” are those that are big enough to withstand a sequence of multiple drought years. They are the backbone of Ceará's water management system. Due to their size and costs, all strategic reservoirs of the state were built with public monies over the past century.

⁷ The GNP of Brazil in 1999 was US\$ 452.4 billion. US\$ 1 = R\$ 2.6 (April 2005). Data from IBGE (2000), and IPECE (2003).

reservoirs and related water infrastructure (Kemper, 1996). This approach, however, has exacerbated water use conflicts, providing no incentives against wasteful water use or in favor of water re-allocation. As will be discussed below, water reform has introduced new practices aimed at complementing this supply-side approach with demand management. Even so, the relationship between water availability and water demand remains still unbalanced in the Jaguaribe River Basin.

Several reasons have been noted for this situation (Cogerh, Engesoft, 1999e). First, water availability during drought periods remains uncertain, due to climatic and hydrological conditions. Water flows, and therefore effective storage, vary considerably from year to year. Dry years are not necessarily followed by other dry years, although this possibility must be planned for. Second, population growth and urbanization in the basin have resulted in more demand for water by domestic and industrial sectors. These sectors have increasingly competed with the dominant water use in the basin, irrigation projects promoted by the federal and state governments in the seventies. Third, *vazios hídricos* — literally meaning “waterless spaces” or regions without water storage systems— continue to exist, especially in the upper basin.

Growing urban demand and inter-basin transfers. A crucial change that has taken place since 1992, is that the Jaguaribe basin has become the main source of water for the expanding Greater Fortaleza region (MRF – *Região Metropolitana de Fortaleza*).⁸ This has generated protests from water users in the Jaguaribe basin, fearful that diversions to Fortaleza could come at the expense of their own water security.

Table 2 shows the total annual water demand for the principal consumptive uses within the Jaguaribe Basin (irrigation, households and industries), and the potential water demand for Greater Fortaleza. During recurrent drought periods, when the water supply system of the MRF is insufficient, the plan is for the Jaguaribe Basin to guarantee the supply of the entire urban and industrial potential demand of the MRF, increasing consumptive use of the basin’s waters to almost 43% of total demand.

⁸ In 1993, after a three-year drought and a threat of extreme water scarcity, the state government built an emergency canal (*Canal do Trabalhador*) that can divert up to 5 m³/s —if necessary— from the Lower Jaguaribe sub-basin to the system of large dams which supplies Greater Fortaleza. Also, the new Castanhão reservoir, the largest in the state with a capacity of 6.7 billion m³, was built mostly to meet increasing urban and industrial demand from Fortaleza. When the construction of the canal “Castanhão – Greater Fortaleza Integration Axis” is completed, it will have the capacity to divert up to 19 m³/s —of the maximum of 22 m³/s that can be released from the Castanhão reservoir— to Greater Fortaleza. The other strategic reason to build the Castanhão reservoir is the hope that the long-discussed diversion from the São Francisco River basin will come about. This diversion, which has been tabled in different shapes over the past 130 years, would provide water to water-thirsty northeastern state outside of the São Francisco basin. In order to receive such a water transfer, Ceará needed the corresponding infrastructure, which it now has.

Table 2. Estimated current water consumption for the main uses within the Jaguaribe Basin and potential water demand for the Metropolitan Region of Fortaleza

Water use	Annual demand		Total (%)
	(million m3)	(%)	
Public Irrigation (Jaguaribe Basin)	202.77	27.3	57.2
Private Irrigation (Jaguaribe Basin)	146.66	19.8	
Domestic (Jaguaribe Basin)	51.95	7.0	
Industrial (Jaguaribe Basin)	22.80	3.1	
Domestic (MRF)*	184.00	24.8	42.8
Industrial (MRF)*	134.00	18.0	
Total	742.18		100

Source: Cogerh, Engesoft, 1999d.

*Demand estimates to be supplied by the Integration Axis, a canal under construction which will divert water from the Castanhão reservoir (Middle Jaguaribe Sub-basin) to Greater Fortaleza.

Intra-basin water scarcity and allocation. In addition to the above, the traditional major management issue in the basin is conflict over intra-basin water allocation. This is mostly a result both of the strong variation of climatic conditions and historic management practices. The most frequent conflicts arise between the users that depend directly on reservoir waters and those located downstream, and among users in the valleys that have been rendered perennial through regulation, henceforth referred to as “regulated valleys”⁹ (Garjulli, Oliveira, Cunha *et al*, 2002). In the Jaguaribe Basin, an innovative management practice referred to as “negotiated water allocation” among users, has demonstrated tremendous potential for mediating and even resolving some of these conflicts. This effort will be discussed in Section 7.

Water quality and environmental concerns. Water quality is another major concern in the Jaguaribe basin, although little is known about how severe the problem is. One of the main sources of declining water quality is the lack of municipal wastewater collection and treatment. Very few municipalities have sewage collection or treatment systems, and those that exist serve only a small portion of the basin’s population. In fact, the majority of urban areas have expanded without adequate sanitation infrastructure. River banks have been massively occupied, and untreated sewage is commonly released directly into rivers and other bodies of water. In addition, although no reliable data exists concerning industrial and non-point source pollution, agricultural practices in the region have generally given little consideration to land degradation and other externalities, such as the impacts of excessive agrochemical use. In turn, river monitoring by the state environment agency (SEMACE - Superintendência Estadual do Meio Ambiente) has not been systematic and only the three major reservoirs have any kind of water quality control program. Available data in the Jaguaribe Basin Plan (Cogeh, Engesoft, 1999f), suggest that there is substantial variation in the water quality of the main river, with critical points

⁹ From the Portuguese “*vales perenizados*”.

and periods of high organic pollution. The plan also identifies a high concentration of fecal coliforms in the major reservoirs and their upstream areas at the beginning of the rainy season (January/February).

All in all, the environmental aspects of river basin management have not yet been incorporated into the state's policy agenda in the same way that has occurred with water allocation and use. However, field interviews suggested that local actors involved in river basin committees and water user associations have substantial concern with these issues. This is a clear change compared to a decade ago when environmental issues in general were entirely superseded by water quantity and allocation concerns.

Recurrent floods. The inter-annual irregularity of precipitation in Ceará raises another management issue: flooding problems. While some years are very dry, rainfall is extreme in other years. When rainfall is high in the Jaguaribe Basin, as occurred in 2004, floods affect various cities, especially those located near the Jaguaribe river in the lower part of the basin. This problem has yet to be dealt with effectively, although some reservoirs, such as the new *Castanhão* dam, the largest in South America for ephemeral rivers, were planned to diminish flooding in the cities.

Inadequate operation and maintenance of water infrastructure. Finally, we should note two other significant issues that reflect the past mismanagement of the water resources, namely inadequate operation and maintenance practices that led to a deterioration in physical infrastructure, and the lack of knowledge about the real availability and utilization of groundwater in the basin (Cogerh, Engesoft, 1999b).

The list of issues above makes it clear that the Jaguaribe basin has been subject to the typical water management challenges encountered in semi-arid regions experiencing population and economic growth. Over a 100-year period, these (increasing) challenges had been addressed within a top-down patriarchal structure, which however did not seem to lead to solutions. In spite of the great investments in water infrastructure, drought and floods continued to affect farmers, and new concerns had to be addressed with the state capital area growing at a rapid pace, from 507,710 in 1960 to 2.1 million in 2000.

The situation was similar in the other basins of the state in 1986. With a new government coming in that focused on modern industrialized and urban development — which implied the need for reliable water supply— a new management approach had to be found. The new water management institutions to be discussed below are in the process of confronting most of these problems.

6. Institutional Arrangements for Basin Management

Before the current reform began in the early 1990s, water resource policy and management in the Jaguaribe Basin, in Ceará state, and in the semi-arid region more generally, was traditionally the domain of federal initiative. The main federal agency for drought prevention —the National Department of Drought Relief (DNOCS – *Departamento Nacional de Obras contra as Secas*)— was created in the 1910s. Since then, it has expended large amounts of federal money for massive construction of water storage infrastructure. In the last century, close to 7,000 reservoirs were built in Ceará, about 130 of which are considered “strategic” and serve multiple water uses (Garjulli,

2001). While the largest and most strategic reservoirs were built by DNOCS, the state government focused on building small ones, usually during drought crises. This supply-based approach was characterized by a centralized, rigid and un-transparent decision-making structure that favored the interests of large landowners and the irrigation projects financed by DNOCS.

The first steps toward institutional change in Ceará were the creation of the Secretariat of Water Resources and the approval of the state Water Law (11.996/1992). The law embraces the main ideas of modern water resource management, following the principles of the – only subsequently developed - federal water law (Law 9.433/1997) and those of other state laws: integrated water management, with the river basin as the planning unit; water as a finite and fragile resource and as an economic good; and decentralized and participatory management. Likewise, Ceará included the same management instruments later instituted by the federal law: state and basin water resources plans; bulk water use permits; bulk water charges; and a water resources information system. However, the political and institutional organization proposed in the state water law is more centralized than in many Brazilian states and in the federal law. For instance, the basin committees have fewer deliberative powers for some issues, especially the definition of the bulk water pricing system which elsewhere is one of their primary competencies. Another significant difference is that, in Ceará, basin committees will not have their own executive support structures (water agencies); the state law defined that technical support should be provided by state management institutions.

The creation of Ceará's Water Resources Management Company (COGERH – *Companhia de Gestão dos Recursos Hídricos*) in 1993, almost two years after the passage of that state's water law, made the differences between the Ceará model and other state systems even more striking, and also more centralized. While most states relied on existing environmental or water agencies funded through the general state budget, in Ceará a strong, independent and eventually self-financed Water Resources Management Company (COGERH – *Companhia de Gestão dos Recursos Hídricos*) was created in 1993 to carry out management, monitoring and enforcement functions. In addition to affirming a new approach to the management of state resources, the creation of COGERH also represented the beginning of a process of taking over control of federal infrastructure in the state, until then mostly governed by DNOCS. Developing the new policies and convincing the water using public to accept these principles was greatly aided through the recruitment and maintenance of staff which were strong from a technical sense and that were extremely dedicated to the new concepts of water resources management. COGERH has recently created seven regional offices (*Gerências Interiores*), four of which are in the Jaguaribe Basin.

Since COGERH was created, the predominant logic has been to centralize the technical aspects of water management as well as the collection of water charges in that agency, with the objective of financing both its administrative expenses and the operation and maintenance of the water infrastructure for which it is responsible. One of the reasons for the decision to centralize water charging, rather than to operate on a basin-by-basin basis as the federal framework proposes, is the need for the redistribution of financial resources among basins in the state, since – except for the Greater Fortaleza Basin - none could be expected to cover their own operating and maintenance expenses.

The creation of basin institutions has occurred gradually over more than ten years, under the initiative and coordination of COGERH and with the support of the State Water Resources Secretariat (SRH – *Secretaria dos Recursos Hídricos*). The result has been the emergence of various types of local organizations, with different features, responsibilities and territorial scales of management, which partially overlap:

- the Jaguaribe-Banabuiú User Commission, which basically defines the annual operating rules of the three major reservoirs of the basin, according to the negotiated water allocation between the users of the regulated valleys;
- 36 user commissions of “isolated strategic reservoirs”, i.e. those that guarantee multiple water use in locally important reservoirs during drought periods;
- 5 sub-basin committees, corresponding to three parts of the basin (Upper, Middle and Lower Jaguaribe) and to two basins of Jaguaribe’s tributaries (Salgado and Banabuiú Sub-basins). Together, they cover the entire territory of the Jaguaribe basin.

Figure 2 shows these local institutions within the Jaguaribe River Basin.

Soon after the process of local mobilization began, it became clear that focusing solely on the hydrographic region (basin, sub-basin or part of a basin) — as called for in the water law—was not the best approach in the semi-arid Northeast. Adaptation to local conditions was necessary. Local stakeholder interactions were most intense around reservoirs and along the regulated river valleys (Oliveira, Garjulli and Silva, 2001).

In the search for solutions to the conflicts that arose during the major 1992-1994 drought, COGERH officials and local stakeholders decided to create a commission of water users to conceive and manage an emergency operation plan for the strategic reservoirs. Based on the way local organizations were already organized, thirty-six commissions of reservoir users and one commission of users in the regulated valleys of the Jaguaribe and Banabuiú Rivers were eventually created out of this pioneering experiment, which was a major departure from previous policies under the federal DNOCS. While their attribution and composition are similar (water users, civil society, and representatives of the key institutions debate and deliberate, together, on the release of water stored in the reservoirs with strategic purposes for integrated water management), there is a significant difference in the territorial scale within which they operate (Figure 2). The Jaguaribe and Banabuiú Valleys Commission covers the valleys of the Jaguaribe and Banabuiú Rivers, regulated by the three major reservoirs of the basin (Orós, Banabuiú and Castanhão). The jurisdiction of a reservoir commission, however, corresponds to a much smaller territorial unit; its main purpose is to guarantee multiple water use in the immediate surroundings of the reservoir during drought periods when rivers dry up.

The five sub-basin committees that exist today in the Jaguaribe Basin were created only several years after stakeholder participation was established through the commissions (Garjulli, Oliveira, Cunha *et al*i, 2002). The committees have broader water management competency than the commission, such as setting guidelines, approving river basin plans and conflict resolution. Their creation, which occurred between 1998 and 2001, was a much more formalized process which had to comply with both national and state regulations.

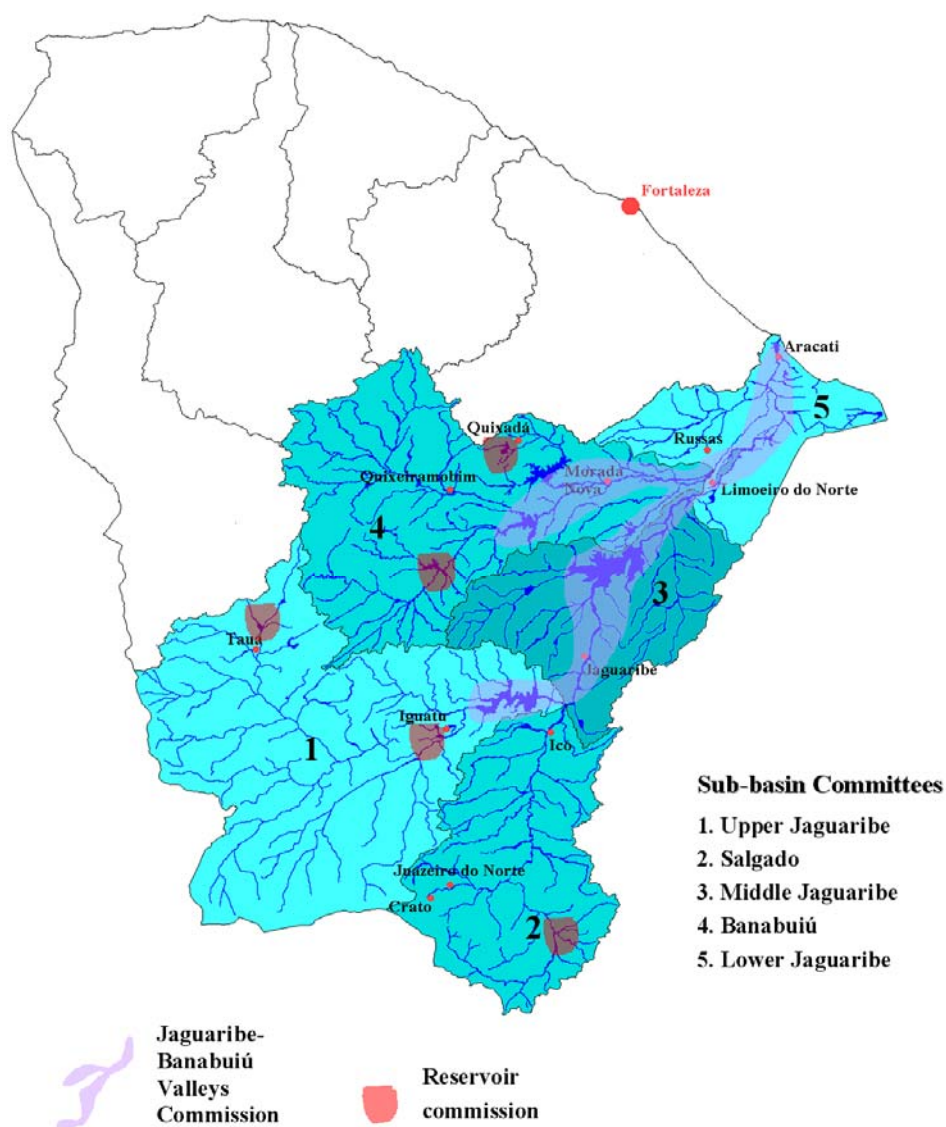


Figure 2. Decentralized institutions of the Jaguaribe River Basin: sub-basin committees, Jaguaribe-Banabuiú Valleys Commission and some of the existing reservoir commissions

Source: developed based on COGERH and field data.

Besides these key institutions for water management in the Jaguaribe Basin, many federal, state and municipal institutions have influence over water issues, as indicated in Table 3.

Table 3. Institutions for water resources management in the Jaguaribe Basin

Management level	Institution	Current water management responsibilities <i>Financial aspects</i>
Federal government <i>Constitutional powers over water legislation, hydropower, and management and control of federal waters</i>	ANA <i>(Agência Nacional das Águas)</i> - National Water Agency	Establishment of the National Water Resources Policy and System. Priority for fighting pollution and drought. <i>Administrative and financial autonomy, funded by the federal budget and by royalties from the hydropower sector</i>
	DNOCS <i>(National Department of Drought Relief)</i>	Protection against drought and flooding, promotion of irrigation in semi-arid regions. In Ceará state: management, operation and maintenance of reservoirs and infrastructure built with federal money, nowadays primarily run by COGERH, established through a written agreement. <i>Funded through the federal budget</i>
State government <i>Constitutional powers over management and control of state waters</i>	SRH <i>(Secretaria dos Recursos Hídricos)</i> - Water Resources Secretariat	Establishment of State Water Resources Policy. Coordination of the state water management system. Responsible for issuing and controlling water permits, with the technical support of COGERH <i>Funded through the state budget</i>
	COGERH <i>(Water Resources Management Agency)</i>	Responsible for the planning and management of state waters, O&M of the hydraulic system, water allocation, introduction and implementation of bulk water charge system, and organization of and interaction with user commissions and basin committees. In addition to its headquarters, COGERH has 7 regional offices in Ceará State. <i>Funded through bulk water charges</i>
	FUNCEME <i>(Fundação Cearense de Meteorologia e Recursos Hídricos)</i> - Foundation for Meteorology and Water Resources	Responsible for meteorological monitoring in Ceará. Provides technical support to COGERH for simulations of reservoir operations and water allocation. <i>Funded through the state budget</i>
	SOHIDRA <i>(Superintendência de Obras Hidráulicas)</i> - Water Infrastructure Superintendency	Responsible for building and maintaining the state's water resources infrastructure <i>Funded through the State Budget and International Loans</i>

	CAGECE <i>(Companhia de Águas e Esgoto do Ceará)</i> (State water and sanitation company)	Provides urban water supply to Greater Fortaleza and most municipalities in the interior of Ceará. Provides sanitation services only to Greater Fortaleza and a very few municipalities in the interior. <i>Funded through water fees and the state budget. Limited recovery of O&M costs.</i>
River basin	Sub-basin committees <i>Formal institutions under state jurisdiction and regulation</i>	Corresponds to the Upper, Middle and Lower Jaguaribe, and to the Salgado and Banabuiú Sub-basins <i>No systematic funding. Occasional financial support from COGERH.</i>
	Jaguaribe and Banabuiú Valleys User Commission <i>Informal institution created by the state (COGERH)</i>	Covering the regulated parts of the Jaguaribe and Banabuiú Valleys (see Figure 2), it includes water users, civil society, and representatives of key institutions. The commission basically decides the annual operation rules for the three majors reservoirs of the basin (Orós, Banabuiú and Castanhão), through negotiations among its members about water allocation, and under the leadership and guidance of COGERH. <i>No systematic funding.</i>
	Reservoir User Commissions <i>Informal institutions created by the state (COGERH)</i>	The 36 reservoir commissions include users and other stakeholders interested in or affected by water allocations in the area of hydrological influence of each “isolated strategic reservoir”. The allocation process they engage in is similar to what occurs in the Jaguaribe-Banabuiú Valleys Commission. <i>No systematic funding.</i>
Municipal government <i>Constitutional powers over land use, urban drainage, and water supply and sanitation</i>	Municipal Secretariats related to urban water infrastructure and management issues	Responsible for managing land use and occupation. Shares responsibility with state government for urban drainage and local environmental issues. <i>Funded by municipal budget</i>
	Municipal Water and Sanitation Services	Only a few municipalities are not supplied by CAGECE and have their own local urban water supply services. <i>Funded by water fees and municipal budgets. Limited recovery of O&M costs. No financial or technical assistance from the state. Partially supported by the Federal Health Agency (FNS - Fundação Nacional de Saúde).</i>

Over time, considerable changes have thus been made in the institutional arrangements originally defined by the state water law. In observing its evolution, one can say that the spirit of the law has been taken seriously and that the institutional landscape of water management in Ceará has been revolutionized over the past one and a half decades. This is the case both in terms of the new actors – the water user commissions and committees, COGERH, the State Water Resources Secretariat, and also in terms of how these actors relate to each other and to the long-established previous actors such as DNOCS, CAGECE, the municipalities, and the individual and industrial water users.

Indeed, Ceará is the state that has progressed the furthest in terms of implementing water reform, overtaking even São Paulo, whose reforms originally preceded and inspired those of Ceará. It was the first state—and the only one until 2003—to implement a system of bulk water charges, which are currently levied on domestic, industrial and some irrigation water uses. This has given COGERH financial self-sustainability. Water management and allocation decision-making for strategic reservoirs has become more democratic and participatory, becoming a sort of informal water rights system. The state and most of the river basins now have water resources plans which reflect more comprehensive and higher-quality knowledge about water problems.

7. Participants' Motivations, Incentives, and Actions

The institutional changes that took place in Ceará and in the Jaguaribe Basin at the beginning of the 1990s have significantly changed power positions. Stakeholders that in the past had little influence over water management now actively participate in water resources management and groups that before were entirely excluded from decision-making have also come onto the political scene. Here we will briefly discuss the way that four organizations or groups—COGERH, DNOCS, SRH, CAGECE and water users—have acted and interacted in the new institutional context and then discuss a series of issues that continue to generate conflict among a broader group of institutions.

COGERH, the state water management agency, has certainly become the most pivotal water management institution in the state, involved in all aspects of water policy. The new agency not only took on responsibilities previously under other jurisdictions, but also filled a vacuum in water management by creating new organizations and policy mechanisms. Only by making such ambitious changes was it possible for COGERH to effectively assume its mission as the state agency for integrated water resources management. One of the first struggles for COGERH to establish itself as an entity to be taken seriously was to take formal control over infrastructure from DNOCS, the agency historically in control of federal reservoirs, and from CAGECE, the state water and sanitation company (Kemper and Olson, 2000).

After dominating for decades management and water allocation of the most strategic reservoirs in Ceará, **DNOCS** did not easily give up this responsibility. It had already been losing influence since the 1970s with its financial and human resources in decline. As a federal agency, responsible for all of the nine states of the Brazilian semi-arid Northeast – the “Drought Polygon”, DNOCS has always had its headquarters in Fortaleza and the larger part of its infrastructure domain has been in Ceará. For this

reason, Ceará was an important state in which DNOCS wanted to retain its power over infrastructure and management decisions. Despite initial and strong resistance, however, DNOCS eventually accepted the transfer of power to COGERH¹⁰. This change was driven by the then new and entrepreneurial government of the State, which wielded considerable influence also at the national government level to be able to bring about this change. It was also supported strongly by the World Bank which at the time was negotiating a loan with the government of Ceará and made it a condition that further World Bank support to hydraulic infrastructure could only be provided if institutional reforms would be put in place to ensure long-term sustainability.

The resilience of the change was demonstrated by the renewal in 2004 of the agreement between DNOCS and Ceará's government through which the former shared powers with COGERH over the management, operation and maintenance of federal reservoirs. At the same time, under a new federal administration since 2002, DNOCS is going through a phase of restructuring. If on the one hand, the agency may be taking on a stronger role in water management in states other than Ceará than in the past (Lemos and Oliveira, 2004), on the other hand, this role is now clearly understood to involve partnership with state governments. In this respect, DNOCS has recently signed a new contract with ANA (National Water Agency) to support participatory management in federal reservoirs in collaboration with state governments, not only in Ceará but throughout the Northeast.

The struggle for control over infrastructure has also taken place between COGERH and CAGECE, the State Water and Sanitation Company. COGERH was supposed to be the bulk water management agency of the state and it was supposed to be self-financed through pricing for its services. Only one basin in the state, the Metropolitan Basin where Fortaleza lies, has an economy that is dynamic enough to generate substantial income through water charges. Since Greater Fortaleza's industries were already paying CAGECE for bulk water before the creation of COGERH, that agency was resistant to giving up this source of revenues. After extensive negotiations, both parties reached a complex agreement which, essentially, has allowed COGERH to take over the Metropolitan basin system. Both industries and CAGECE itself are charged for bulk water, but the former pay 60 times more than the latter (for details, see Kemper and Olson, 2000). Apart from this initial squabble, CAGECE can be said to have mainly benefited from the advent of COGERH and the new water resources management system in the state. Being responsible for supplying Greater Fortaleza with water, it has an interest in well-managed water resources and in transparency regarding the availability of water on a seasonal basis. At the same time, CAGECE is a strong stakeholder in the system and not a very efficient water company. As in many other places worldwide, it is also in Ceará politically difficult to charge adequate tariffs for domestic water supply and sanitation services, and the state government, which determines tariffs, has not raised them to a level that would permit CAGECE to stand on its own financial feet. That is also the reason why CAGECE pays far less to COGERH for the bulk water it receives than the industries do although ultimately it is the principal beneficiary of the bulk water

¹⁰ The transfer of power was only with regard to water resources infrastructure, not however, public irrigation perimeters, which remain under or affiliated to DNOCS to this day, even in those irrigation perimeters that were partially transferred to farmers.

interbasin transfer out of the Jaguaribe basin. In the case of other **water users**, we must distinguish the “privileged users” from the rest. Even in the absence of a formal water rights concession system, some user groups have traditionally had priority in gaining access to water, especially irrigation projects run by DNOCS, large users and agribusiness, and, of course, human consumption, which is guaranteed first priority by law. Generally, these privileged users are also the most organized groups in the basin, with greater economic and political resources. Such groups cannot be expected to see benefits in changing the water resources management system. Those who have not been privileged historically —such as fishermen, *vazanteiros*¹¹, and smaller irrigators— would however theoretically benefit most from formal water rights, decentralization and participatory management (Kemper, 1996). And, in practice, such groups have indeed benefited most over the last decade from the “negotiated allocation” processes, through which groups representing larger numbers of less powerful users have finally gained a voice. This is not to say that large and medium-sized users have been excluded from the process. Indeed, they still tend to dominate the water allocation negotiations. However, less privileged users and civil society groups have also gained access to a process in which, previously, they had no say at all.¹²

The user commissions are more inclusive than the basin committees and the water allocation process is notable for its transparency, since users and other local stakeholders decide the volumes to be released from the reservoirs as well as the use and conservation rules that must be respected by all users. Furthermore, while no user can be certain of the exact amount of water to which they will have access year after year —actual water availability is only known at the end of each rainy season—, the system has increased the reliability of supply for all water user groups, albeit sometimes in smaller amounts than many would prefer. The result has been that over the last few years substantial reductions in water use have occurred in the Jaguaribe Basin (COGERH, 2000, 2001 and 2002). This has prevented more serious water shortages – common in the past. However, the user commissions are still only informal institutions.

Understanding the relationships among actors involved in water management in the basin requires not only looking at how federal-to-state and state-river basin decentralization has affected the relationship among them, but also how the institution of new water management instruments affects the interests of varying groups.

The negotiated allocation of water through the user commissions co-exists uncomfortably with an emerging formal water permit system. Water use permits, which the state SRH has slowly begun to issue with the help of COGERH (Cogerh, Engesoft, 1999g; Baltar, Azevedo, Rêgo and Porto, 2003), are not required to respect the decisions of the user commissions. A proposal is on the table to grant permits for longer periods, coupling them with the negotiated allocation process as it is practiced, for example, in the Northern Colorado Water Conservancy District, USA (Kemper, 1999). This would give

¹¹ When the water level in a reservoir recedes, due to outflows or evaporation, the rim of humid soil that is uncovered is called a *vazante*. Farmers, mostly small subsistence farmers, who cultivate in these areas are called *vazanteiros*. *Vazanteiros* can also be found along rivers.

¹² These conclusions are based on interviews in February 2004, confirmed by Ballesterio (2004) cited by Lemos and Oliveira, 2004.

users the security of holding permits for a specific period while specific amounts would be negotiated each year, based on water availability. Currently, however, water permits have for the most part not been monitored or enforced, meaning that permit holders have few advantages over unauthorized users. Furthermore, some users are suspicious of formal permits, fearing that obtaining them will make them more susceptible to being charged for water in the future.

The introduction of water charges is also raising tension in the Jaguaribe basin. While the negotiated allocation of water was largely met with approval, COGERH is facing opposition from the users and local stakeholders to implementing this management instrument. Currently, only water and sanitation companies, which use only 12% of the water from the Jaguaribe Basin, pay into the system, according to the same rules that apply elsewhere in the state: charges are only for water that is measurably used, in another departure from the national model.¹³ Given that water in the Jaguaribe Basin is mostly used for low-value agriculture, irrigators are largely unwilling and unable to pay at levels that would compensate for what COGERH spends on operating and maintaining water infrastructure in the basin.

In recognition how difficult it would be to convince Ceara's farmers to pay for bulk water under these conditions¹⁴, COGERH has followed another strategy: to start by charging the major users in the Metropolitan basin. This basin has both the majority of industrial users, the sector for whom water charges would have the smallest relative impact on cost structures and the water supply system with the greatest potential to be financially self-sustainable. At the state level, charges were introduced gradually, starting with municipal users in 1996, industrial users in 1998 and only in 2000 expanding to a very small number of irrigators. Today, the Metropolitan Basin still contributes over 90% of the total collected revenues. COGERH currently charges industries 15 times as much as it charges the water supply system in Greater Fortaleza and 30 times more than the water companies elsewhere, including in the Jaguaribe Basin. When pricing was first introduced, the difference between the charges for industries and water companies was even greater. Industries did not resist paying COGERH, however, because the prices were still only half of what CAGECE had been charging previously. COGERH has plans to expand state water charges, starting in 2004, to gradually include irrigation, shrimp farming, fishing and other uses. However, this effort has proven difficult, as was observed by the authors during field work. On the one hand, water users and civil society organizations have increasingly raised criticisms that COGERH has been non-transparent with respect to how it defines prices and determines how proceeds will be used. It should be noted, however, that local stakeholders apparently do not question the centralization of pricing at the state level, an acceptance that is explained by the fact that most users are served by public water supply infrastructure and that most of Ceará's basins are

¹³ The dominant vision of water charges in the country is that pricing is based on use permits rather than on measured use. In turn, three types of water use permits would be granted, as stated by the new Brazilian legislation: for withdrawal, for consumption, and for effluent dilution (i.e., the volume of water needed to reach the concentration of pollutants set by standards in the water body where effluents are released).

¹⁴ For an exhaustive analysis of this issue in the Curu basin, see Kemper 1996.

underdeveloped and therefore benefit from the transfer of revenues from charges from the Metropolitan Basin.¹⁵

On the other hand, irrigators continue to resist the introduction of water charges. An attempt was made in 2001-2002 to introduce charges for this sector in the Jaguaribe basin, combining it with other management instruments. The *Águas do Vale* (Valley Waters) program was conceived and implemented by Ceará State and the National Water Agency (ANA) and has often been referred to as “a form of water trading” (COGERH, n.d.). However, the results were not encouraging. In 2001, with reservoirs at a perilously low level, it became clear that the water stored in the Jaguaribe reservoirs would be insufficient to supply all irrigators in the Jaguaribe and Banabuiú valleys, despite the fact that negotiated water allocation had led to reduced consumption. Since 59% of all water demand in the Jaguaribe-Banabuiú valleys came from rice producers using flooding as an irrigation method, the program’s key feature was a mechanism to compensate them for their lost production if they agreed to shift to less thirsty and more profitable crops such as cantaloupe and banana. The general objective of the program was reached in terms of reducing consumption, since reductions were sufficient to allow all demands to be satisfied in the basin that year. Financial compensation was clearly effective in providing incentives for users to reduce consumption and to re-allocate water to more efficient activities, with lower water consumption and higher production values, according to the internationally well-known motto ‘more crop per drop’. But the efforts to charge those that did not change their practices were less successful. The program collected only about 20% of the amount charged and less than 10% of the total amount expected (Osny, 2003). Considering the high level of non-payment (80%) —which means that many irrigators received enough water for normal production without paying— it is not surprising that some local actors considered the experiment a failure and that the program lost credibility. When questioned about how to explain these results, SRH and COGERH employees emphasized the rushed process of designing the program, problems in implementation, the resulting lack of an information system, and the lack of political will to charge big irrigators¹⁶. Apparently, though few paid the charges, all rice irrigators who joined the program received compensation for non-production. In the following year, the program was discontinued and these farmers went back to rice production.

Finally, it should be noted that the institution of the bulk water pricing system is met with substantial resistance from users and civil society at large because they fear the creation of a water market in the Jaguaribe basin. Even COGERH and SRH officials are generally unconvinced about the idea of water trading, even though a pilot water market project has been approved through a contract between Ceará state and the World Bank.

In summary, the motivation of the different key stakeholders converges in the sense that all see a benefit in river basin management. Water users, especially the more underprivileged ones, appreciate that they have a seat at the table – something which they

¹⁵ In most of Brazil, basin committees not only negotiate the values of the charges directly with users but also decide how proceeds should be used, according to the priorities set by basin plans. This is what is proposed by the federal and most of the states’ water legislations, and applied since 2003 in the Paraíba do Sul River Basin, in the southeast of the region. More details can be found in Formiga-Johnsson and Lopes (eds), 2003.

¹⁶ Interviews with SRH and COGERH’s officials in February, 2004.

never used to have before. At the same time, institutional change in the Jaguaribe basin has developed so far that the management instruments, such as bulk water charges, water permits and allocation mechanisms are on the table. There seems to be a divergence in terms of the definition and implementation of these instruments. Water users want to have more of a say in these – guarding their interests to reliably receive water at the lowest possible cost to them – while the state seems to assume that the involvement of users at the current level, i.e. mainly discussions, information and negotiated allocation, is sufficient devolution of power to the river basin level¹⁷. This issue is further explored below.

8. Applying the Analytical Framework

Examining the factors identified in the analytical framework of Section 2 will contribute to our ability to understand the impact of decentralization on the Jaguaribe River Basin and on Integrated Water Resource Management.

8.1. Initial Conditions and Contextual Factors

At the time that reform began, local conditions in the Jaguaribe basin seemed unfavorable to the development of a decentralized and integrated water resources management in several respects.

First, the basin is characterized by poverty, even in the Brazilian context. The political and economic development that occurred in the middle and lower parts of the basin (Jaguaribe and Banabuiú Valleys) during the 1970s —a result of construction of very large reservoirs— was not enough to change this general picture. Today, Ceará accounts for only 1.8% of all of Brazil's wealth, mostly concentrated in the Metropolitan Basin, where the state capital Fortaleza is located (IBGE, 2004; IPECE, 2003).

Second, the proposal of participatory water management diverges in fundamental ways from the political culture of the Ceará hinterlands (*sertão*), since until the reforms began, water there had historically been considered either a private good, the property of the owners of the lands through which it flowed or under the control of the government agencies of the reservoirs within which it lay (usually DNOCS). Ceará had one of the most entrenched oligarchies in the Northeast, characterized by clientelist practices and the power of political bosses. The large landowners who dominated state politics benefited from continuing low industrialization, significant agricultural subsidies, cheap water and large infrastructure projects including the construction of reservoirs on their own lands (Furtado, 1959 and 1987; Kemper and Olson, 2000). Third, the way water resources were distributed among basin stakeholders prior to reforms strongly favored irrigation projects promoted by the federal and state governments in the seventies. Irrigators in the basin account for about 83% —or 342 million m³ per year— of total water consumption in the basin, with 37% for private activities and 46% for government projects. Most of the conflicts in the basin involve this sector. Thus, one would have expected that reforms would not succeed.

¹⁷ Interviews during field visit in July 2004.

At the same time, however, other factors favored reform, especially in the broader context within which the changes would take place. At the national level, the transition to democracy, that followed the fall of Brazil's military regime in the mid-1980s, was accompanied by broadened acceptance throughout Brazilian society of values such as democratization, decentralization, and participation in policy making. At the same time, at the national level an unprecedented movement within the technical water resource community began to promote integrated water resources management. This movement, led in large part by the Brazilian Water Resources Association, had a strong impact on the dissemination throughout the country of certain management models, such as water use rights, pricing, and river basin level management (Formiga-Johnsson, 1998). At the same time, at the state level, in the context of a new generation of state government leadership who had a more modern vision of development compared to the landed elite that had dominated the state's policies for so long, and who initiated a more generalized reform of Ceará's administrative structure in the same time period, the creation of innovative institutional arrangements for water resource management at state and basin levels was favored. This process was also supported by the World Bank in the context of the implementation of the state water law of 1992.

In Ceará, specifically, the key enabling factor was the existence of strong political will in the form of advocates for the adoption of a new form of management of water resources. A succession of Governors and leading government officials over a time period of over 12 years furnished the stable political support required for the adoption of such radical changes in water policy. This coupled with the recruitment and maintenance of staff who were strong from a technical point of view and extremely dedicated to the new concepts of water resources management aided greatly in the process of developing the new policies and convincing the water user public to accept these principles. Thus, the change in the state political environment in the mid-Eighties helped overcome the other rather unfavorable factors and was crucial to break the path dependence of water resources management in the state.

With the results in hand, one can say that the reformist context, both within the state and the country, worked together to overcome very strong vested interests that would otherwise have been expected to stall any serious attempt towards decentralization.

8.2. Characteristics of the Decentralization Process

Contrary to water management practices in the humid South and Southeast of Brazil, the semi-arid region has had a long history of federal intervention. Thus, the decentralization process in the Jaguaribe basin was marked by two distinct processes: i) decentralization from federal to state level, a result of the increased technical, institutional and financial capacity of Ceará's water resource management agencies; and ii) decentralization from state to local level, which occurred through the creation of deliberative and consultative bodies at the river basin and lower territorial levels.

The creation of COGERH was not part of the original design called for in the state water law (Law 11.996/1992), but resulted from the World Bank's insistence that the state create a water agency with management, monitoring and enforcement functions, including pricing and the involvement and organization of local stakeholders (Kemper

and Olson, 2000). The fact that in 1997 COGERH took over some of DNOCS's management responsibilities represented a major step towards decentralization from federal to state level. The sustainability of this federal to state decentralization process has been demonstrated over time. As, several times, elections have brought changes in the party control of both state and federal governments, state control over federal infrastructure has continued, as demonstrated by the renewal of the contract between DNOCS and COGERH in 2004, discussed above. Indeed, there are signs that federal-to-state devolution is increasing, such as a recent agreement between COGERH and the National Water Agency delegating authority for issuing use permits for waters in federal reservoirs¹⁸. Even DNOCS never acquired such authority.¹⁹

The state-to-local decentralization process has been more complex. It can clearly be characterized as a top-down initiative, in which COGERH's User Mobilization Department (DOU) played a central role. The Department employed a group of sociologists who, in the effort to implement participatory management practices, were able to manage a delicate balance between the sometimes centralizing tendencies and interests of a state-level institution, and local interests and customs (Formiga-Johnsson and Scatasta, forthcoming). The fact that the state government took the initiative in decentralization was clearly the result of their efforts, considering that as a whole and in spite of a clear shift in development outlook, the state government was still under the influence of powerful elites who questioned both allowing new actors into the decision-making process and decreasing the role of the central state government.

Recent changes, in fact, demonstrated that the commitment of the current state government to the devolution of decision-making to local bodies is fragile (Lemos and Oliveira, 2004). In 2003, the DOU was dismantled, revealing that the priorities of the current leadership in the state government are different. Upper echelons at COGERH and the State Water Resources Secretariat are increasingly distrustful of the participatory decision-making bodies that were created. Although the long-term impact of these changes on the user commissions and river basin committees is still unclear, reform-oriented officials hope that the high level of mobilization achieved in the basin over the last ten years will make it difficult to undo the advances made thus far²⁰.

¹⁸ The fact that only one of Ceará's rivers is federal could lead one to believe that the relationship between Federal and State government is less relevant in Ceará. This interpretation would be, however, incorrect, since the constitutional norm of 1988 (art. 26) grants federal control over waters collected by federal projects, even when these are built on state rivers.

¹⁹ This is one of the first of what ANA plans to be a series of *Convênios de Cooperação* (ANA, 2003, 2004) through which the agency will delegate some of its responsibilities to state agencies, especially water use permits for federal waters. In most cases, ANA plans to establish the agreements only after the implementation of an institutional support program to create or strengthen state agencies. The new policy will likely have a major political impact on the national water resource system, especially since many state governments feared that the creation of ANA signaled a new process of centralization of decision-making about federal waters (Formiga-Johnsson and Scatasta, forthcoming).

²⁰ These conclusions are based on interviews in February and July 2004 and are confirmed by Lemos and Oliveira (2004) who discuss this issue in length.

8.3. Central-Local Relationships and Capacities

The devolution of some of DNOCS's authority over the management and control of reservoirs to Ceará state has been highly effective, since COGERH has developed substantial technical, administrative and financial management capacities. Currently, COGERH operates and manages, through its agreement with DNOCS, all major reservoirs in the state, accounting for over 90% of the state's water storage. But other aspects of water management remain underdeveloped. The state has proceeded only slowly with the implementation of groundwater management. The development of a new water use permit system has also been slow, despite the fact that criteria and procedures were basically defined some time ago. A recent World Bank study characterized the permit system as still in consolidation (Baltar, Azevedo, Rêgo and Porto, 2003). It should be taken into account, however, that making water rights into a full-fledged instrument of water management, as proposed by the current reforms, is a major challenge, since until recently, water permits were no more than a bureaucratic instrument. In short, for climatic and even cultural reasons, the state so far has privileged reservoir operation and water allocation over other important issues such as the implementation of water use permits, the extension of bulk water charges to the irrigation sector and the management and control of groundwater use.

While federal-to-state decentralization has undoubtedly advanced substantially, the process of devolving authority and responsibility from the state to local levels is less easy to characterize in terms of success or failure.

The basin committees —which were supposed to be the most important basin institution — can be characterized as formal institutions that still have not found a *de facto* place in the water management system. On paper, they have many competencies. In practice, however, they are unable to carry out most of them, since they lack effective technical, administrative and financial support. Contrary to the national framework, which places river basin committees and agencies at the heart of decision-making about water pricing, Ceará has centralized water charging at the state level. This means that, in Ceará, basin committees will not have their own executive arm (basin agencies), nor will they have financial resources of their own. With most of their expenses provided by members themselves or by the occasional financial support of COGERH, the committees still have little influence over water resource management. Their activities have been limited to information dissemination, awareness raising and capacity building among local actors and the resolution of water use conflicts. Contrary to what the state water law proposes, major structural projects continue to be decided solely by the state government, especially with respect to supplying water to Fortaleza. A COGERH plan is being formulated which will define an executive support structure to replace the partial technical support that its regional offices have been providing the committees thus far. But COGERH has apparently yet to define both its own role in the basin's institutional set-up and the relationship it should have with either the committees or users' commissions. Importantly, in addition to the political change in leadership in the state and its agencies, such as COGERH, the agency has also come under tremendous pressure with the creation of the National Water Agency ANA. At least 80% of the most competent staff of the State of Ceará in the area of water resources management have left the state and are now employed at the national level. This is in part due to the significant

efforts of the Federal Government in the recruitment of the well-recognized staff of Ceará and partly due to the dissatisfaction of the staff with the new policy directions.

Conversely, decentralization in the Jaguaribe Basin has gone furthest with the user commissions, especially through the negotiated allocation of water, which, as discussed above, has proven very effective (Garjulli, 2001; Formiga-Johnsson, 2001; Garjulli, Oliveira, Cunha *et al.*, 2003; Lemos and Oliveira, 2004; Ballesteros, 2004; and Formiga-Johnsson and Scatasta, forthcoming). However, within COGERH and the SRH (to which COGERH is subordinate) there has been resistance to giving decentralized bodies greater power over water management. The result is that only the sub-basin committees have been legally created, but these have received little real support or authority. Meanwhile the Jaguaribe-Banabuiú Valleys Commission —where the process of participatory decision-making began and has continued with great intensity — is still only an informal institution. This contradictory situation has created tensions between the sub-basin committees and the Jaguaribe-Banabuiú Valleys Commission, as will be discussed in the next section. Uncertainties thus prevail about the real extent and intentions of the devolution of authority and responsibilities from the state to local level in Ceará. However, the importance of negotiated water allocation in the Jaguaribe basin and its national and even international prestige, may assure the continuity of this process.

Finally, we should note that the transformation of water management practices in Ceará seems to need more time to reach full implementation. Certainly, reform is still underway in the Jaguaribe Basin. Considering that the process is already ten years old, this suggests that there are significant transaction costs in terms of time, even in one of the most advanced cases of water reform in Brazil.

8.4. Internal Basin-Level Institutional Arrangements

Water allocation is the most prestigious activity in the basin, with the greatest local impact and hence the greatest capacity to mobilize local actors. This importance has recently led some representatives of the Executive Board of most sub-basin committees to argue that the Jaguaribe-Banabuiú Valley Commission should be dismantled, with the transfer of its responsibilities to the committees, as occurred in Ceará's Curu River Basin.²¹ This would involve a fundamental rearrangement in basin institutions, since four of the five sub-basin committees are involved with the regulated valleys. In the Curu basin, the transfer of power from commission to committee was simpler because the territorial jurisdiction of the user commission fell entirely within the geographical area of a single committee.

However, before rethinking the competencies of these local bodies and their relations with each other, it is necessary to determine the extent to which decentralization down to units that are smaller than the river basin has been positive. The division of the Jaguaribe into three parts (upper, middle and lower) has no correspondence either to hydrological criteria or to any pre-existing social, economic or environmental form of organization. When the committees were created, the decision to divide them this way

²¹ The tension between the sub-basin committees and the main valley commission in the Jaguaribe Basin were strongly noted during field work in February and July 2004.

was based on logistical and operational criteria, since COGERH's Department of User Organization was unable to operate immediately in the entire basin. The solution was to create committees in sub-basins in the short run, with the plan to join them together later into a single committee. Some still support this plan, while others have proposed creating a separate basin-wide committee whose objective would be to coordinate decisions made by the smaller scale bodies and, principally, to take over the water allocation responsibilities currently held by the Jaguaribe-Banabuiú User Commission.

While the committees and the Jaguaribe-Banabuiú User Commission are sources of controversy, all actors in the basin and at the state level have shown support for the 36 reservoir user commissions. The allocation process they engage in is similar to that carried out by the Jaguaribe-Banabuiú Valleys Commission, but the decisions have only very localized impact and transaction costs are lower. Usually, the commissions include only users or groups of users directly affected by water allocations in the area of hydrological influence of a single reservoir, since members are mostly made up of organizations working in the perimeter of the reservoirs, and in the immediate downstream area. Despite the current uncertainties concerning institutional boundaries, both user commissions and basin committees have been promoting the resolution of water use conflicts, with the support of COGERH. They have come to be perceived as the legitimate space for negotiating conflicts in terms of water allocation and quantitative use, and for airing other controversial issues related to water quality and environmental degradation.

9. Performance Assessment

Evaluating the performance of river basin management institutions should focus on three critical characteristics of effective decentralization, i.e. devolution of authority, stakeholder participation, and financial self-sufficiency, as well as on the actual physical changes that have occurred due to the changes in decision making – e.g. more efficient, effective and equitable water allocation, decrease in flooding events and/or their impacts, and environmental quality of the water body. In the following sections, we will briefly explore each of these characteristics with respect to the Jaguaribe River Basin experience.

9.1. Devolution of Authority

As should be clear by now, the devolution of federal authority over the management and operation of federal reservoirs to Ceará State has been highly effective. Federal institutions continue to develop, support and finance specific drought relief programs in the semi-arid region, together with state governments and sometimes with international organizations. The *Águas do Vale* Program (see section 7), which can be considered a demand-supply approach for irrigation, is an example of such partnerships.

Decentralization from state to local level has been more partial. Although COGERH has decentralized the allocation of strategic reservoir waters to local institutions, many traditional water management competencies continue under COGERH's purview, such as water permit concession, bulk water pricing, planning, operation and maintenance of hydraulic infrastructure, groundwater management and

control, etc. Furthermore, none of the changes introduced thus far have affected municipalities, which are still fully responsible for land use and urban drainage.

9.2. Stakeholder Participation

The creation of sub-basin committees and user commissions, under COGERH's coordination with the support of the State Water Resources Secretariat, has allowed for the involvement of hundreds of stakeholders of all types, such as municipalities, public and large private irrigators, fishermen, and industry leaders. Although so far stakeholder involvement has been limited largely to the negotiated allocation of water and to conflict resolution, these experiences are still a radical transformation in management practices. Also, the participatory nature of the process appears to increase users' sense of ownership, that is, they are not only users, but also managers and "stewards" of the resource.

However, local stakeholders still have no say in some decision-making processes that affect them directly, such as bulk water pricing or inter-basin transfers to Greater Fortaleza, which continue solely under the control of state government agencies. In this sense, the decentralization proposed in the state water law was not translated into practice. Also, the concerns of local stakeholders with respect to water quality problems and broader environmental problems related to water have yet to find a place on the agenda of the state water institutions.

9.3. Financial Self-Sufficiency

At the basin level, the financial resources of decentralized institutions are both precarious and insecure. Neither the basin committees nor user commissions have their own financial resources, depending totally on contributions from the state government and from their own members. This makes them vulnerable to any top-down changes that may occur.

At the state level, though, bulk water pricing has represented an important change in terms of financing water management. Until pricing was introduced, bulk water supply services were partially or fully subsidized by public institutions. The pricing system has enabled COGERH to gradually achieve financial sustainability for its operation and maintenance costs and for investments in new water infrastructure (Azevedo and Asad, 2000). Although Ceará is one of Brazil's poorest states, collected revenues, state-wide, have grown substantially over time, from R\$ 268,410 (US\$ 103,235) in 1996 to about R\$ 10,000,000 (US\$ 3.85 million) in 2003.²² Payment reached 83% of the total revenues in 2003, when 10 of the expected 12 million reais were actually collected.

The Metropolitan Basin —the state's principal urban and industrial area— contributes over 90% of the total revenues from bulk water pricing. Among the user-payers, the domestic sector is currently the largest contributor (65% of the total), followed by industry (34%). Irrigation contributed only 1% of the total collected revenues. The result is that the degree of cross-subsidization within the state for water

²² US\$ 1 = R\$ 2.6 (April 2005).

management costs is enormous, both among user sectors (from industries to the domestic and irrigation sectors) and regionally (from the metropolitan basin to the other basins). This means that the operation and maintenance costs of the large water infrastructure in the Jaguaribe River Basin are currently subsidized by users in the Metropolitan Basin. It is likely that even with the expansion of the bulk water pricing system, expected to begin in 2005, proceeds generated within the basin will still be insufficient for the investments in infrastructure and water monitoring that are planned. In effect, most of the water basin's users are irrigators who pay almost symbolic amounts. Therefore, we can expect both continued subsidization from the Metropolitan region and government funding for larger infrastructure projects to be necessary.

8.4. Changes in Riverbasin Management Outcomes – Strengths and Weaknesses of the Institutional Arrangements in the Jaguaribe River Basin Case

Water Allocation. Compared to the allocation process followed by DNOCS in the decades before COGERH took over, the water allocation process has become both more effective, more efficient and more equitable. Nowadays water users are convened every year after the rainy season and informed about water availability, including stochastic model results for the coming year. This is the foundation of the negotiated allocation process, which permits water users to plan their production accordingly once the shares of each one have been agreed.

The process is not only more efficient, but also more equitable because also traditionally weak user groups are included, get access to information and have a kind of informal water right. This system considerably reduced the moral hazard approach in which DNOCS would keep information to itself and supply water users —usually the well-connected ones— to its liking. The negotiated water sharing system also permits water users to avoid the impacts of dry years and thus become more drought resistant.

That said, the fact that the Jaguaribe basin is viewed as the “water cow” that will supply water to the ever growing state capital region, is stressing the new arrangements, which is leading to the increased efforts regarding water trading described above.

Flooding. With the completion of Castanhão reservoir in 2002, the cities located near the Jaguaribe river, especially in the lower part of the basin, gained greater protection against flooding, as the heavy rainy season of 2004 proved.

Environment. Water management in the Jaguaribe Basin, and Ceará more generally, has, thus far, focused on improving water infrastructure and optimizing use and allocation, the privileged arenas of hydrological engineering. Broadening the scope of river basin management to include, for example, water quality management, ecosystem preservation and other environmental issues, has yet to come. Despite these concerns, it seems that the most pressing agenda for stakeholders in the basin is not to expand the scope of the water resources management system, but rather to consolidate the advances made thus far.

8.5. Other Perspectives on the Decentralization Process in the Jaguaribe Basin – The Way Forward

First, policy makers have to establish how negotiated water allocation fits into the formal institutional arrangements for water resources management. Proposals for the combination of inter-annual permits (issued by the state) and annual negotiations to determine the available amount under rationing conditions (decided informally by the user commissions) seems to be a good way to adapt water allocation policy to the specific conditions of the semi-arid region. This would eliminate the contradiction between a formal, but weak, system and an informal but highly legitimate one.

Secondly, the state government has yet to overcome the skepticism of the irrigation sector with respect to the bulk water pricing system. The expansion of the charging system, currently under way, has been criticized by local stakeholders, who complain that COGERH and the state government have made unilateral decisions, with little debate with Basin committees.

Many of these problems are, however, the result of the fact that the state has failed to demonstrate clarity and certainty with respect to the level of decentralization to be pursued in the water management system. Indeed, COGERH has yet to define both its own role in basin organization and the relationship it should have with basin committees and user commissions. Some argue that if the system is to be made compatible with the spirit of the water laws, that is, if it is to become more decentralized and participatory, COGERH's current policies towards the basin-scale institutions would have to be reformulated substantially (Teixeira 2004). Above all, COGERH will have to decide if it will become a water agency for all the state's basins, instead of serving as only a sort of occasional support mechanism. If it chooses to take this path, it will need first to build legitimacy and this will require breaking with traditions of closed-door decision-making and centralized administration, especially with respect to bulk water pricing. It will then have to adopt mechanisms gradually leading to a system in which management responsibilities are shared with those who pay for bulk water use and in which the committees have deliberative power and can supervise its activities. But the recent dismantling of the Department of User Organization – which has functioned to date as the main liaison between COGERH and local organizations – sends a signal in the opposite direction.

The success that has made the Ceará model so famous in Brazil and internationally has depended on two factors: the capacities and expertise of COGERH and the involvement and mobilization of local stakeholders. But not only are COGERH and local stakeholders in constant tension and even competition, but also the various stakeholder bodies that have been created have yet to establish a clear division of labor. Consolidating Ceará's success will depend on finding the right balance between these forces.

10. Conclusions

The case study of the Jaguaribe River Basin is a fascinating example of integrated water resources management at the lowest appropriate level. In the first place, it suggests that even when pre-existing conditions are almost entirely unfavorable, changes leading to more integrated and decentralized practices are possible. The analytical framework developed for the larger World Bank research project of which this case study is part (section 2) would suggest that the political and institutional situation of Ceará and the Jaguaribe basin (sections 8 e 9) was largely adverse to the increase of stakeholder involvement and transparency in decision-making. But when the decentralization model was tailored to these conditions, it was possible to begin to overcome them.

A second issue that this paper has brought up has to do with how change occurs. What happened in the 1990s that made it possible to transform practices that had been operating for decades? Water scarcity and conditions of almost permanent rationing certainly were motivations for change. But these conditions existed before. Perhaps more important were the national post-dictatorship context —highly favorable to democratization and decentralization— and the fact that a reform movement within the water resources sector began to promote integrated, participatory and economically sustainable management throughout the country in the 1980s. Both of these conditions, however, could describe all Brazilian states, most of which did not make the advances in decentralized water management that we have described in Brazil. Certain conditions specific to the Ceará context facilitated the adoption of the reform proposals in that state. A combination of an innovative state government, with an entrepreneurial orientation, and strong long-term support from the World Bank for reform in the water sector were critical for putting water security and management made on the top of that state's political agenda.

The high incidence of poverty in Ceará, its regional disparities, the limited capacity of user sectors to pay for water and the high cost of bulk water supply have, however, meant that Ceará's law does not entirely correspond to the decentralization model that was later developed in the federal legislation and most state laws. That model is centered around the creation of river basin committees and basin agencies with financial sustainability guaranteed through bulk water pricing. But in the Jaguaribe river basin – and in Ceará as a whole– the state government began to play a much more proactive role in water resources management, primarily through COGERH. In a sense, the adaptation made in the Ceará case was simply less decentralization from the state to local levels than the national model and even the state's own water law proposed. The presence of large hydraulic works throughout the state, which must be operated in close coordination if recurrent droughts are to be dealt with effectively, justifies this more centralized system. Moreover, the fact that the metropolitan area is dependent on the Jaguaribe basin, and will become even more so in the future, means that few at state level defend full decentralization. Water from the Jaguaribe basin is diverted not only to protect the city from domestic supply crises but also to guarantee steady economic growth. State politicians thus fear that if water allocation were fully the responsibility of each river basin body, the largest city in the state would risk losing access to the water from other basins that is essential for its dynamism. At the same time, what is particularly interesting about this approach is that water management is more centralized in Ceará

than elsewhere, local mobilization and stakeholder involvement is also more intense than anywhere else in Brazil.

A third conclusion of this paper is that the “lowest appropriate level” for decentralization is not always the river basin. As for negotiated allocation and conflict resolution, the user commissions serve as strong building blocks for integrated management. The sub-basin committees are still trying to define their roles and powers. Their creation, however, is a consensus at local level and they have increasingly mobilized local actors around water issues. The essence of Ceará’s experience in the Jaguaribe River Basin may thus be that the river basin scale is less relevant there for integrated water management purposes, in favor of combining state level management with decision-making at smaller territorial levels than the river basin, such as sub-basins, regulated river valleys, and reservoirs. This suggests that, although the principle of the river basin as a unit for decentralized management should be kept as a target, it must be tailored to each political and cultural context.

Finally, it should be stressed that much remains to be done, especially with respect to building a more holistic management system that incorporates efforts to promote better water quality and to coordinate water and environmental management. Nonetheless, the achievements made thus far are remarkable when compared to the problems and practices that seemed, until recently, impossible to overcome. Water rationing in the Jaguaribe Basin used to be an almost permanent state of affairs. Traditional institutions used to privilege the interests of entrenched oligarchies. Civil society and small users were excluded from water related decision-making. Water was, in general, managed and protected in only the most precarious and unsustainable of ways. All these unfavorable factors have been strongly challenged and will continue to challenge efforts to build a decentralized and integrated water resource management system in the Jaguaribe River Basin.

The achievements already made are thus quite impressive. It is too early, however, to establish firm conclusions about the political stability of the process. Only the future will tell if the 12-year long decentralization process described here, a process that was initiated and strongly supported by a succession of political leaders, and implemented by highly professional and dedicated staff, has yet been institutionalized enough to survive the current period of ‘political drought’ that started with the change in state and institutional leadership in 2003.

Acronyms

ABRH	Brazilian Water Resources Association (<i>Associação Brasileira de Recursos Hídricos</i>)
ANA	National Water Agency (<i>Agência Nacional de Águas</i>):
CAGECE	Ceará's Water and Sanitation Company (<i>Companhia de Água e Esgoto do Estado do Ceará</i>)
COGERH	Ceará's Water Resources Management Agency (<i>Companhia de Gestão dos Recursos Hídricos</i>)
DNOCS	National Department of Works Against Droughts (<i>Departamento Nacional de Obras contra as Secas</i>)
DOU	COGERH's User Mobilization Department (<i>Departamento do Organização de Usuários da COGERH</i>),
FNS	Federal Health Agency (<i>Fundação Nacional de Saúde</i>)
FUNCEME	Ceará's Foundation for Meteorology and Water Resources (<i>Fundação Cearense de Meteorologia e Recursos Hídricos</i>)
IBGE	Brazilian National Statistical Agency (<i>Instituto Brasileiro de Geografia e Estatística</i>)
PROGERIRH	Ceará Integrated Water Resources Management Project (<i>Programa de Gerenciamento e Integração de Recursos Hídricos</i>)
PROURB	Ceará Urban Development and Water Resources Management Project (<i>Projeto de Desenvolvimento Urbano e Gestão de Recursos Hídricos do Ceará</i>)
SEMACE	Ceará's Environmental Agency (<i>Superintendência Estadual do Meio Ambiente</i>)
SOHIDRA	Ceará's Hydrological Works Superintendency (<i>Superintendência de Obras Hidráulicas do Estado do Ceará</i>)
SRH/CE	Ceará's Water Resources Secretariat (<i>Secretaria Estadual de Recursos Hídricos do Estado do Ceará</i>)

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Appendix: Variables in the Analytical Framework

As noted in Section 2, the analytical framework used for this research project entails several variables hypothesized to be related to the success or failure of river basin management institutions, grouped into four categories.

Contextual factors and initial conditions

The literature on decentralized water resource management indicates that successful decentralization is at least partly a function of the initial conditions that prevail at the time a decentralization initiative is attempted. These initial conditions are elements of the social context of the decentralization effort. They include

- Economic development of the nation;
- Economic development of the basin area;
- Initial distribution of resources among basin stakeholders; and
- Class, religious, or other social/cultural distinctions among basin stakeholders.

Characteristics of the decentralization process

In countries that have attempted to decentralize water resource management to the basin level, characteristics of the decentralization process itself will affect the prospects for successful implementation. Two necessary conditions of a decentralization initiative are (a) devolution of authority and responsibility from the center, and (b) acceptance of that authority and responsibility by the local or regional units. Whether (a) and (b) occur will depend in part upon why and how the decentralization takes place. Important factors include

- Whether basin-level management was a local initiative to assume management responsibilities, a devolution that was mutually desired by local stakeholders and central government officials, or a decision by central government officials to shed water resource management responsibilities regardless of whether basin stakeholders wanted to assume them;
- The extent of central-government recognition of local-level basin governance; and,
- Whether central government officials maintained a policy commitment to decentralization and basin management through transitions in central government administration.\

Characteristics of central government/basin-level relationships and capacities

Because successful decentralization requires complementary actions at the central government and local levels, other aspects of the central-local relationship can be expected to condition that success. Political and institutional variables should be explored that relate to the respective capacities of the central government and the basin-level stakeholders, and the relationship between them. Key factors include

- The extent to which devolution of water management responsibilities from central government to basin institutions has been real or merely rhetorical, and whether devolution has been handled as a supportive transition to basin management or as an abrupt abandonment of central government authority;
- The financial resources available to basin-level institutions, and the extent of their financial autonomy;
- Basin management participants' ability to create and modify institutional arrangements that are tailored to their needs and circumstances;
- The extent of other experience at the local or regional level within the country with self-governance and service provision;
- The distribution (particularly asymmetries) of national-level political influence among basin stakeholders;
- Characteristics of the water rights system in the country which facilitate or hinder basin management efforts; and
- Whether basin-level institutions have had adequate time for implementation and adaptation of basin management activities.

The internal configuration of basin-level institutional arrangements

Successful implementation of decentralized water resource management will also depend on features of the basin-level arrangements created by stakeholders and/or central government officials. Important ones include

- The presence of basin-level governance institutions;
- The extent of clarity of institutional boundaries, and their match with basin boundaries;
- Whether and to what extent basin-level institutional arrangements recognize sub-watershed communities of interest;
- The availability of forums for information sharing and communication among basin stakeholders;
- The ability to make, monitor, and enforce contingent contracts whereby basin stakeholders can agree to contribute to improvements in basin conditions;

- The institutionalization of regular monitoring of basin conditions by means that are trusted by water users; and
- The availability of forums for conflict resolution.

Certainly, these factors will not all apply with equal significance in all cases. In each case, the emergence and path of river basin management will be affected profoundly by some of these variables, affected slightly by others, and not at all by some. Institutional analysis in a case-study setting consists largely in determining which institutional factors in what combination appear to have been linked to outcomes. Furthermore, many of the variables listed above have subjective components, and will be assessed differently by different participants and observers. It is therefore essential in these case studies that team members interview individuals with a variety of perspectives.